A Review on Effects of Waste Foundry Sand, Glass and Glass Fiber on their Properties

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Abstract - *The aim of this study is to find out the effects of waste foundry sand, glass and glass fiber on their property. Due to ever increasing quantities of waste materials and industrial by-products, solid waste management is the prime concern in the world. Scarcity of land-filling space and because of its ever increasing cost, recycling and utilization of industrial by-products and waste materials has become an attractive proposition to disposal. There are several types of industrial by-products and waste materials. The utilization of such materials in concrete not only makes it economical, but also helps in reducing disposal concerns. Three such industrial by-product is (WFS), (WG) and (GF). Waste foundry sand is major byproduct of metal casting industry and successfully used as a land filling material for many years. But use of waste foundry sand for land filling is becoming a problem due to rapid increase in disposal cost. In an effort to use the waste foundry sand in construction materials, research has been carried out for its possible utilization in making concrete as partial replacement of fine aggregate. Here, the influences of (WFS), (WG) and (GF) as cementing material and effect of this on their mechanical properties of concrete investigated. Glass is widely used in our lives through manufactured product such as sheet glass, glassware, and vacuum tubing. Glass is an ideal material for recycling. The use of recycled glass helps in energy saving. The increasing awareness of glass speeds up inspections on the use of waste glass whit different forms in various fields. One of its significant contributions is to the construction field where the waste glass was reused for concrete production. The application of glass in architectural concrete still need improvement.*

Key Words: (WFS): Waste Foundry Sand, (WG): Waste Glass, (GF): Glass Fiber, (SFS): Spent Foundry Sand, (UFS): Used Foundry Sand.

1. INTRODUCTION

Concrete is the most widely used man-made construction materials in the world. Slightly more than a ton of concrete is produced each year for every human being on the planet fundamentally, concrete is economical, strong, and durable. Although concrete technology across the industry continues to rise to the demands of changing market place. The construction industry recognizes that considerable improvements are essential in productivity, product performance, energy efficiency and environmental performance the industry will need to face and overcome a number of institutional competitive and technical challenges. One of the major challenges with the environmental awareness and scarcity of space for land-filling is the wastes/byproduct utilization as an alternative to disposal. Throughout the industrial sector, including the concrete industry, the cost of environmental compliance is high. Use of industrial by-products such as foundry sand, glass & fiber glass can result in significant improvement in overall industry energy efficiency and environmental performance. The consumption of all type of aggregates has been increasing in recent years in most countries at a rate far exceeding that suggested by the growth rate of their economy or of their construction industries. Artificially manufactured aggregates are more expensive to produce, and the available source of natural aggregates may be at a considerable distance from the point of use, in which case, the cost of transporting is a disadvantage. The other factors to be considered are the continued and expanding extraction of natural aggregates accompanied by the serious environmental problems. Often it leads to irremediable deterioration of the county side. Quarrying of aggregates leads to disturbed surface area etc. but the aggregates from industrial wastes are not only adding extra aggregate sources to the natural and artificial aggregate but also prevent environmental pollution.

Foundry industry produces a large amount of by-product material during casting process. The ferrous metal costs in foundry are cast iron and steel, none ferrous metal are aluminum, copper, brass and bronze. Over 70% of the total by-product material consist of sand because molds usually consist of molding sand, which is easily available, inexpensive, resistance to heat damage, easily bonded whit binder, and other organic material in mould. Foundry industry use high quality specific size silica sand for their molding and costing process. This is high sand than the typical bank run or natural sand. Foundries successfully recycle and reuse the sand many times in foundry. When it can no longer be reused in the foundry, it is removed from the industry, and is termed as waste foundry and (WFS). It is also known as spent foundry sand (SFS) and used foundry sand (UFS).

Waste foundry sand, glass & fiber glass are by-products which appears to possess the potential to partially replace regular sand, as a fine aggregate in concretes, providing a recycling opportunity for them. If such types of material can be substituted partly/fully for natural sand (fine aggregates) in concrete mixtures without sacrificing or even improving strength and durability, there are clear economic and environmental gains. Currently, very limited literature is available on the use of these by-products in concrete. Waste foundry sand (WFS) glass & fiber glass are the major issues in the management of foundry waste. WFS are black in color and contain large amount of fines.

1.1 Scope of paper

Cement is the most costliest and energy intensive component of concrete. The unit cost of concrete can be reduced by partial replacement concrete with waste foundry sand, glass and glass fiber. The disposal of waste foundry sand, glass and glass fiber is one of the major issues for environmentalists as dumping of waste foundry sand, glass and glass fiber as a waste material may cause severe environmental problems hazards. Instead of dumping it as waste material, it can be partly used as pozzolana for partial replacement of cement, on the other hand 75 to 80 percent of concrete is made of aggregates. In order to reduce the usage of natural aggregate, recycled aggregate can be used as the replacement materials. This can reduce the cost as well as heat of hydration. However, workability is lowered and hence the mix warrants the use of Super plasticizer. Concrete with conventional materials suffers from low tensile strength, limited ductility and little resistance to cracking. These problems may overcome by inclusion of glass fibers in concrete. The Scope of the present investigation is limited to the determination of Compressive strength, Split tensile strength and Flexural tensile strength of M30 grade glass fiber reinforced concrete with partial replacement (40%) of cement by waste foundry sand based the concrete using recycled Aggregate at 7 days, 14 days, 28 days, and 56 days. Modulus of Elasticity and water absorption were determined at 28 days.

2. Literature review

Sharath Babu Khedagi (2017): In this investigation M30 grade of concrete is considered for the study. Here cement is constantly replaced with metakaolin by 15% and fine aggregate is partially replaced with WFS in various percentages such as 5%, 10%, 15%, 20% and 25% and using glass fibers 0.5% by weight of cement. The result shows that the concrete with 0.5% glass fibers, 15% constant replacement of cement by metakaolin and 10% replacement of fine aggregate with WFS gave maximum strength. Water absorption was less for 10% substitution WFS, metakaolin and glass fiber as the WFS content increases Water absorption increases. As the WFS content increases loss in strength due to acid attack increases, but 10% substitution WFS showed less loss in strength. However WFS can be replaceable up to 20% because it gave strength that is comparatively higher than CC. (1)

Abhishekh Soratur, Ajay B K, Soumya P Hiremath, Tejashwini P Maganur, Rajesh S J (2018): compressive strength of, splitting-tensile strength and flexural strength test results of concrete mixtures was increased with foundry sand and glass fiber. At the age of 28 days sand content is replaced by foundry sand and addition fibers shows compressive, Spilt tensile, flexural strength was increased. Waste foundry sand can be successfully used in making great quality ready-mix concrete as partial Supplanting of fine aggregate.

Environmental effects from wastes and disposal problems of waste can be reduced through this research.

A better measure by an innovative Construction Material is formed through this research. (2)

Dushyant R. Bhimani, (2013): We can say that for 1m3 M20 grade of concrete consumption of fine aggregate is 538.45 kg. Here in specimen M-4 we replace fine aggregate by 162 kg of foundry sand for 1m3 M20 grades of concrete. So, we can say that up to 30% foundry sand utilized for economical and sustainable development of concrete. Uses of foundry sand in concrete can save the metal industry disposal costs and produce a 'greener' concrete for construction. An innovative supplementary Construction Material is formed through this study. (3)

Gurptreet singh, (2012): compressive strength of both grades of concrete mixes (M20 and M30) increased due to replacement of fine aggregate with the waste foundry sand, glass and glass fiber. However, compressive strength observed for both grades of concrete mixes were appropriate for structural uses. (4)

J. Suneel, P.S.S. Anjaneya Babu, (2015): The strength of concrete decrease whit increase in the percentage of recycle aggregate, this may be because of the loose mortar around the recycle aggregate which do not allow the proper bonding between the cement paste and aggregate. The strength (30 Mpa) is generally used for a wide range of structural uses. At 28 days 100% replacement of RCA with addition of fly ash achieved strength of 32 Mpa. (5)

P sudheer, M G Muni Reddy, S.S.S.V Gopala Raju, (2016): Incorporation of fly ash as cement replacement in fresh glass fiber reinforced concrete increases workability when compared to reference concrete made without fly ash. The M3 MIX shows good workability when compared with all the mixes. The addition of glass fiber into the concrete mixture did not improve its ultimate compressive strength. It is observed that the glass fiber did not recover the compressive strength loss of fly ash. (6)

Jinliang Liu, Yanmine Jia, and jun wang, (2019): the paper considered the effect of volume ratio of additions on the fiber reinforced concrete. Because of the positive effect of bonding force between fibers and cement paste, the compressive and flexural strength of fiber reinforced

Concrete showed an obviously higher value than the plain specimen. (7)

Anand Bhagat, Vikram Singh, Ankit Mahajan, (2020):

Waste foundry sand can efficiently improve mechanical properties of Concrete. At 28 days compressive strength was found to be 33.79N/mm2

Maximum at 20% WFS replacement with sand. Moreover, compressive Strength was marginal increase with ages from (28-56 days) 56 days Shows Compressive strength of 37.76 N/mm2.

Split-tensile, flexural strength for concrete containing WFS was increased

Than conventional concrete. Split tensile strength and flexural strength

For 28 days cure concrete show maximum value of 2.97 N/mm2 and 7.35

N/mm2 at 20% WFS replacement. (8)

Ramniwas, (2018): The present work investigated the influence of waste foundry sand as partial replacement of fine aggregate (sand) on the properties of two grades (M20 & M30) of concrete. (9)

S.P. Gautam, Vikas Srivastava and V.C. Agarwal, (2012):

While using waste glass as fine aggregate replacement, 28 d strength is

Found to marginally increase up to 20% replacement level. Marginal

Decrease in strength is observed at 30 to 40% replacement level of

Waste Glass with fine aggregate.

Waste glass can effectively be used as fine aggregate replacement

The optimum replacement level of waste glass as fine aggregate is 10%. (10)

Yasser Sharifi*, Iman Afshoon, Zeinab Firoozjaei, and Amin Momeni, (2016): The compressive, splitting tensile and flexural strengths of the GWG (Ground waste glass) & SCCs (self-consolidating concrete) increased with an increase in GWG micro particles content up to 20 %, vice versa as the GWG content increased more than 20 %the strengths have been decreased. The concrete containing 5 % GWG micro particles resulted in the highest strength properties. There was more than 18 % improvement in the compressive strength of GWG-SCCs with 5 % GWG micro particles substitution in comparison with the control mixture, but mixture containing 20 % GWG was comparable to the control mixture. The variation of compressive strength is ranged 0, 18.01, 11.49, 7.72, 5.08, -3.99 and -10.15 % from Mix-0 (control specimen) to Mix-30 containing 30 % GWG, respectively. (11)

Vikram singh (2020): the researcher studied behavior of waste foundry sand, waste foundry of glass and fiber glass to addition into concrete.

The primary focus is to study mechanical properties of concrete in fresh

And hardened state.

The researcher did an experimental test, the researcher tried M20 (1:1:2).

They studied the mechanical properties in 7days, 14 days, 28 days and 56 days.

After obtained the final results from 2nd, 3rd, 4th trial (the researcher did

4 trial) it is compared whit 1st trial made whit conventional concrete to see If the usage of these materials used in concrete individually and in

Combination produce satisfactory strength or not and has a potential to be used in concrete. (12)

3. CONCLUSIONS

From this study the following conclusion maybe made out of the study:

1- As according to the previous paper I have studied it shown when we add waste foundry sand in concrete, however strength of concrete increase.
2- To adding waste foundry sand from 10 to 20% the strength of concrete will increase.
3- Less than 5% if we add waste foundry sand it will not gave us the proper result and also the strength will not go up.
4- Addition of waste foundry sand on concrete it's an easy way to increase the pressure and flexural strength of concrete.
5- Whit addition of waste foundry sand, glass and glass fiber it have more benefits as I will mention here.
6- Whit adding waste foundry sand, waste glass, and glass fiber it will be economical, it will high strength, we will use the waste that didn't use in nature.
7- It will be more environmentally friendly and will use the wastes that will throughout on the nature.
8- It's a best way to decrease the waste of sand and glass.
9- M 20 (30Mpa) grid concrete mix obtained increase in 28 day compressive strength from 30 Mpa to 37.8 Mpa on 15% replacement of fine aggregate whit WFS, whereas it increase was from 40 Mpa to 46.8 Mpa for M30 grade of concrete mix. Maximum strength was achieved whit 15% replacement of fine aggregate whit WFS. Beyond 15% replacement it goes to decrease for both grades of concrete, but was still higher than control concrete.

ACKNOWLEDGEMENT

These acknowledgements attempt to thank people who in some way supported, guided and encouraged me along the way to completing this review. I would like to express my sincere thanks to the University of Chandigarh for giving me the chance to undertake my studies and for providing a supportive learning environment.

I acknowledge and express thanks to my supervisor, Asst. Professor Vikram Singh for the professional guidance he gave me while writing this review.

I want to sincerely thank the almighty God for the gift of life and strength to complete this review. Finally, to my family, thanks for the sacrifices, patience, love and support throughout my review.

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